ENVIRONMENTAL PLANNING

Ecosystem Restoration / Mitigation (techniques / examples)

Do not go where the path may lead, go instead where there is *a* path and

Student Learning Objectives

- Familiarize yourself with several basic habitat restoration techniques.
- Review restoration / mitigation examples.
- Identify sources of topical expertise and information.
- View Corps ecosystem restoration project examples.

National Restoration Objectives:

- **Recognize vital contribution of wildlife resources and require equal consideration with water resources development programs, FWCA 1958**
- ***Enhance environmental quality* as one of four objectives to be considered in seeking the most feasible plan for improving human well-being, WRPA 1965.**
- ***Restore and maintain environmental quality* for overall human welfare and development, NEPA 1969.**
- ***Protect and recover T & E species* through ecosystem conservation, ESA 1973.**

Ecosystem Restoration Techniques

- **Remember Ecosystem Restoration is**
  - **<u>Rehabilitation</u> of existing ecosystems ;**

- ***Remember The Corps' Ecosystem Restoration Mission is to* restore degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition.**

- **Remember the Corps policy is to implement this mission by utilizing its engineering and biological expertise, and**

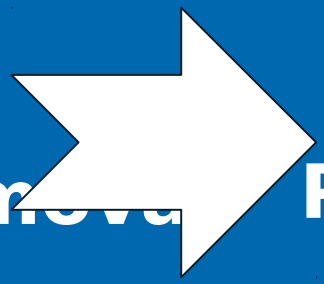
- **this typically means we the manipulate geomorphology and hydrology by "moving dirt and water"!**

Existing Need

- 235,000 miles of Channelized Stream in U.S.
- 50% Wetland Reduction Nationwide
- 62,000 acres of wetlands lost between 2004 – 2009.
- 98% Riparian Habitat Loss in Southwest
- Over 1300 T&E Species
- 78,000 large dams in U.S.
- Impounded water 5X fre

Examples of Restoration / Mitigation Techniques

1) Dam removal
2) Alternatives to dam removal
3) Stream restoration
4) Wetland restoration
5) Beneficial use of dredged material
6) Water control structures
7) Artificially Placed Natural Structure
8) Operational Management of Projects



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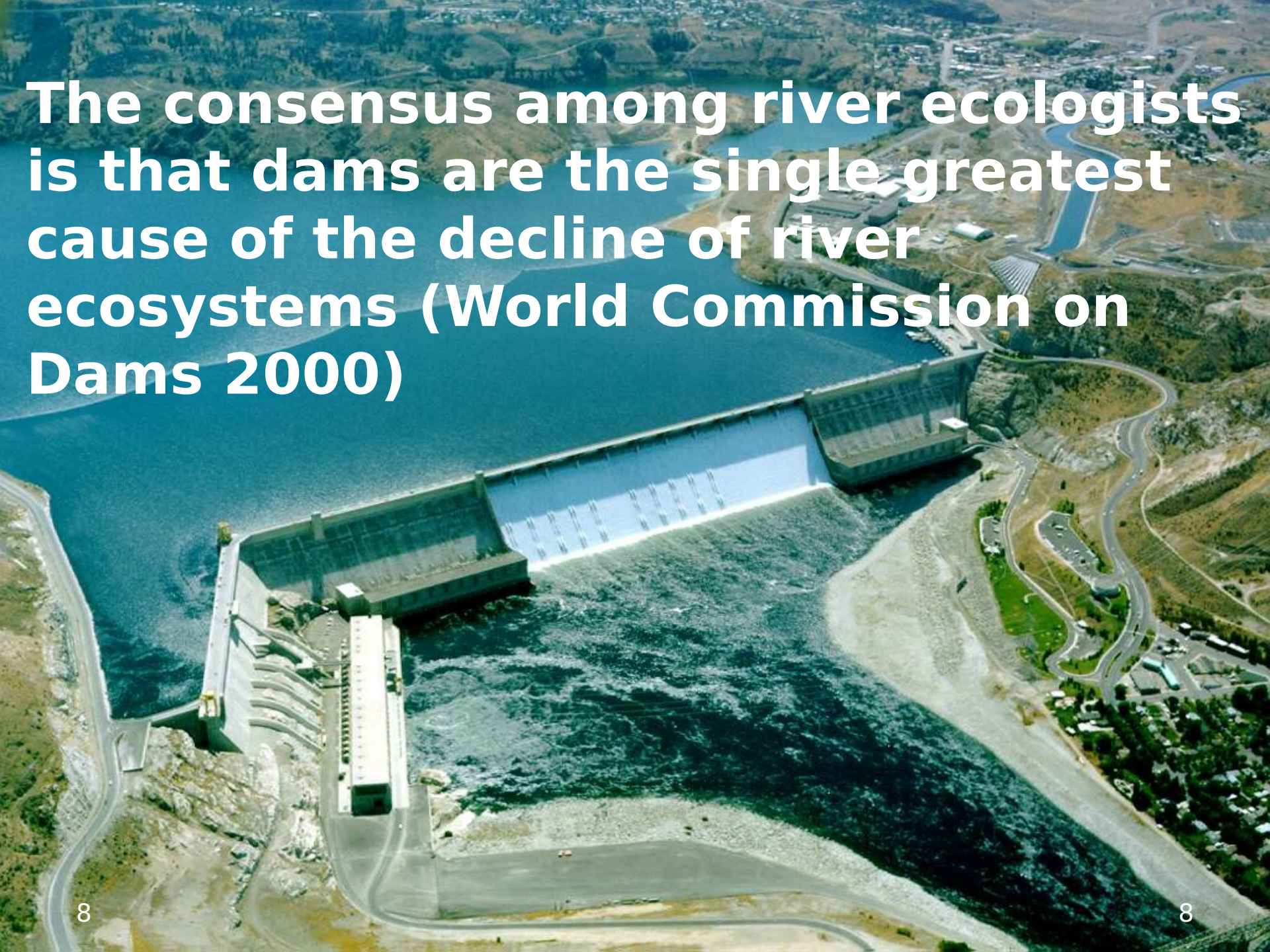
1. Dam Removal

- Restore the stream to a more “natural” condition.
- Should always be considered the 1st and best option for fish passage.
- Exceptions:
- 1. Dam still provides important fun
- 2. Known contaminants behind the
- 3. Invasive fish species (i.e., Asian



The consensus among river ecologists is that dams are the single greatest cause of the decline of river ecosystems (World Commission on Dams 2000)

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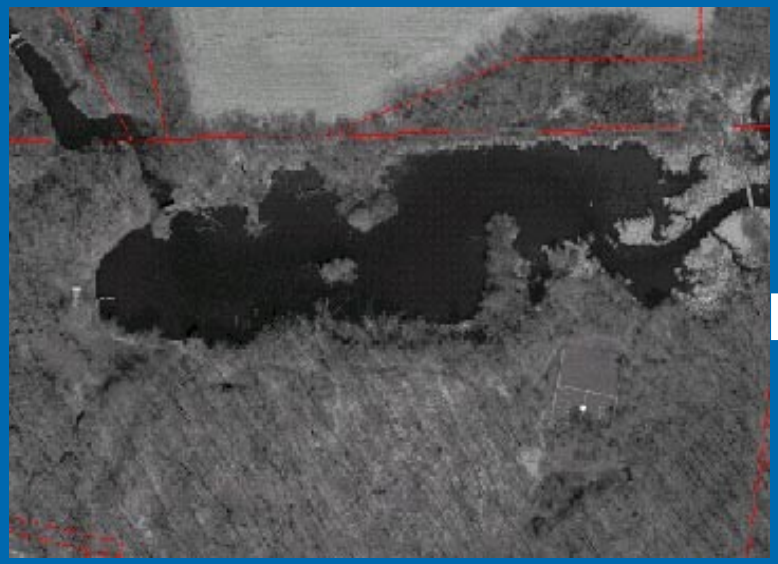
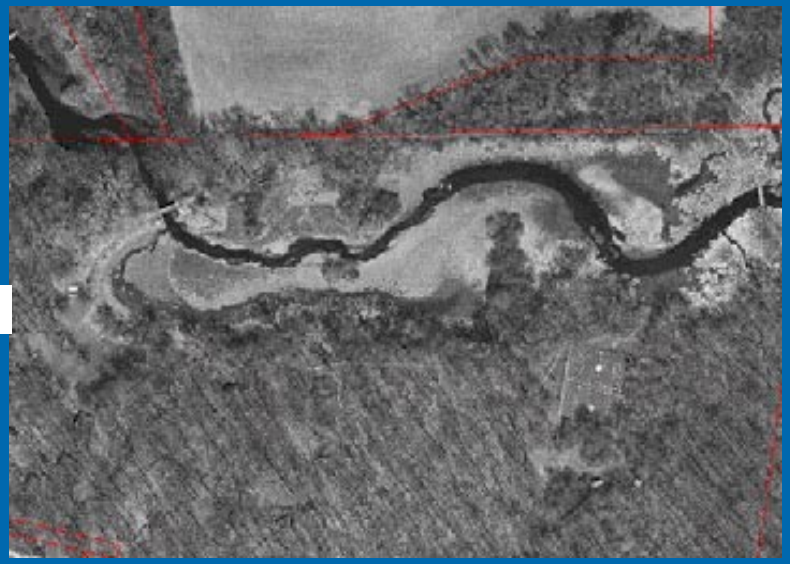
Trade-offs



Dam Removal

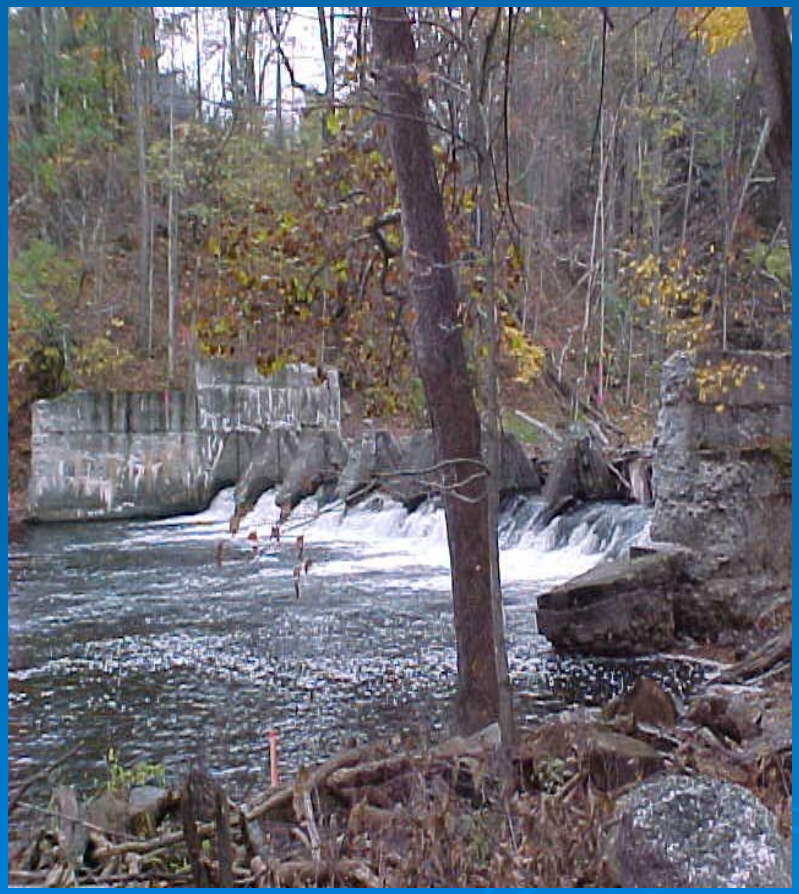


- Lentic Habitat (lake)
- Largemouth bass
- Plankton
- Motorboat recreation

- Lotic Habitat (riverin
- Smallmouth bass / Sh
- Benthos
- Kayak/canoe recreati

Cuddebackville Dam Removal

Cuddebackville, NY – Section 206
Sponsor – The Nature Conservancy
Benefits: migratory fish and federally-listed mussel



Before (10/2003)

After (10/2004)

2. Alternatives to Dam Removal

- Fish ladders
- Natural rapids / rock ramps
- Natural bypass channels

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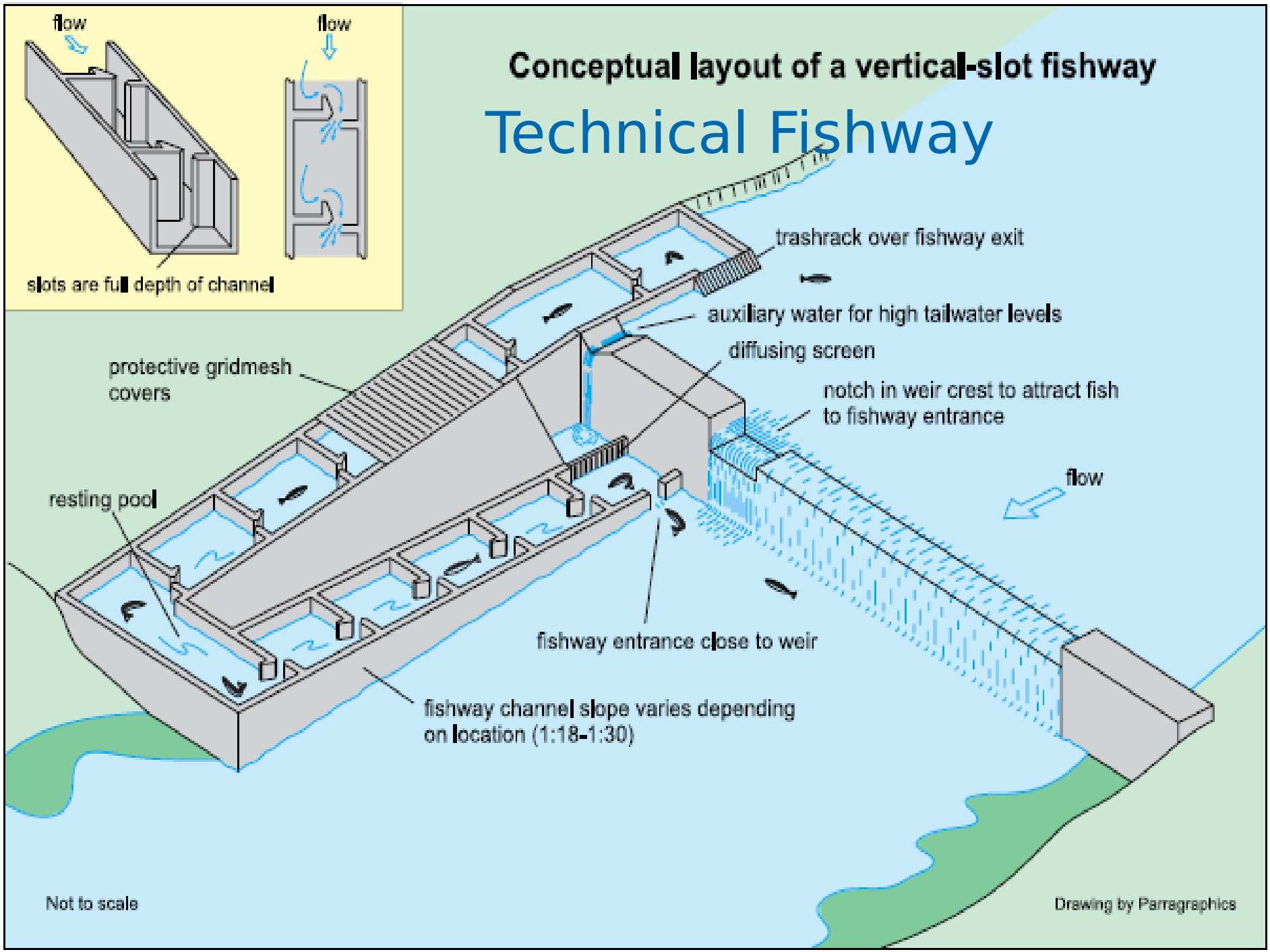
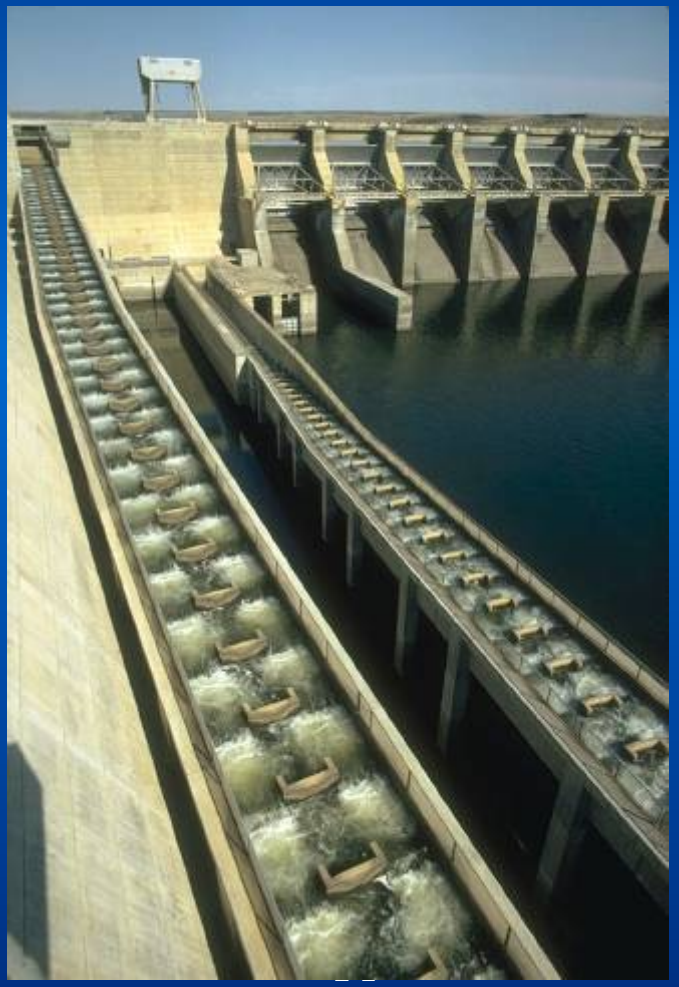
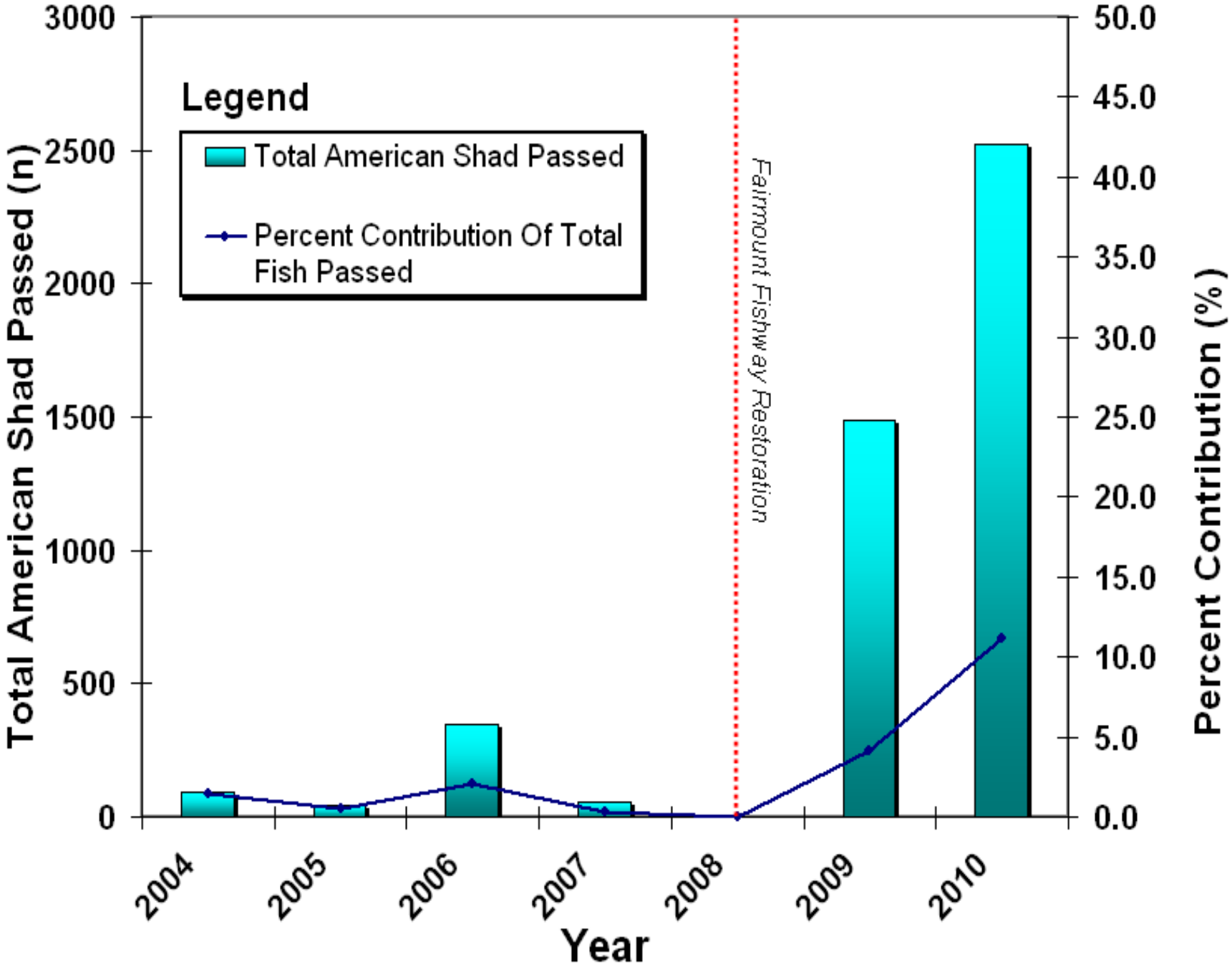

Conceptual layout of a vertical-slot fishway
Technical Fishway
flow
flow
slots are full depth of channel
trashrack over fishway exit
auxiliary water for high tailwater levels
diffusing screen
protective gridmesh covers
notch in weir crest to attract fish to fishway entrance
flow
resting pool
fishway entrance close to weir
fishway channel slope varies depending on location (1:18-1:30)
Not to scale
Drawing by Parragraphics

Fish Ladders

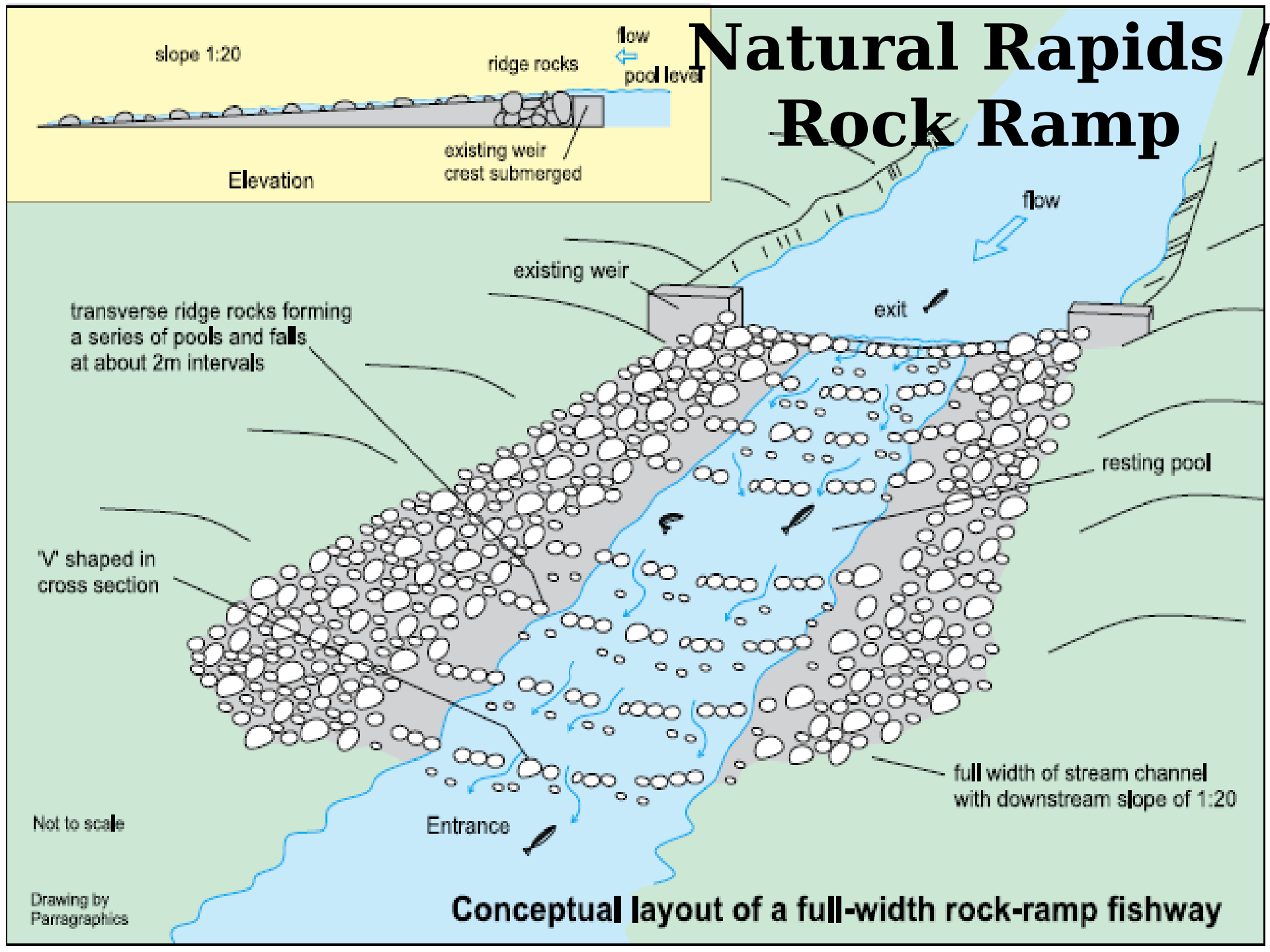
Little Goose Lock and Dam - Snake River



Fairmount Fish Ladder
Philadelphia, PA


Legend
Total American Shad Passed
Percent Contribution Of Total Fish Passed
Fairmount Fishway Restoration
Total American Shad Passed (n)
Percent Contribution (%)
Year
3000
2500
2000
1500
1000
500
0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2004
2005
2006
2007
2008
2009
2010

Natural Rapids / Rock Ramp

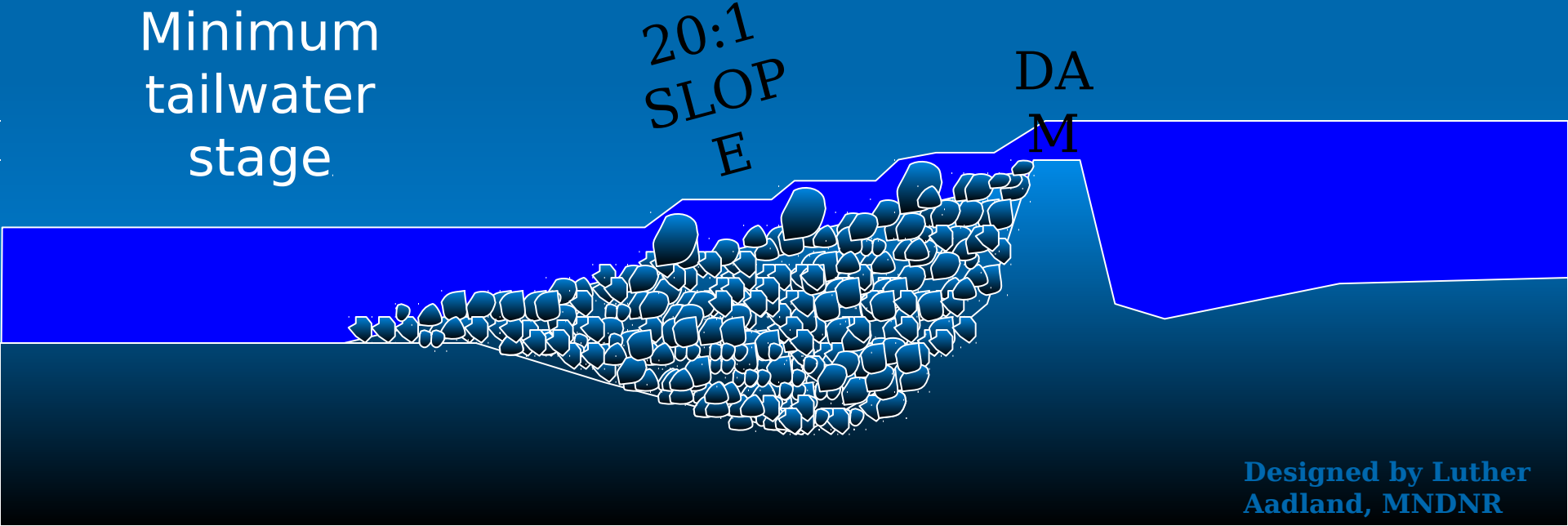


Conceptual layout of a full-width rock-ramp fishway

Natural Rapids

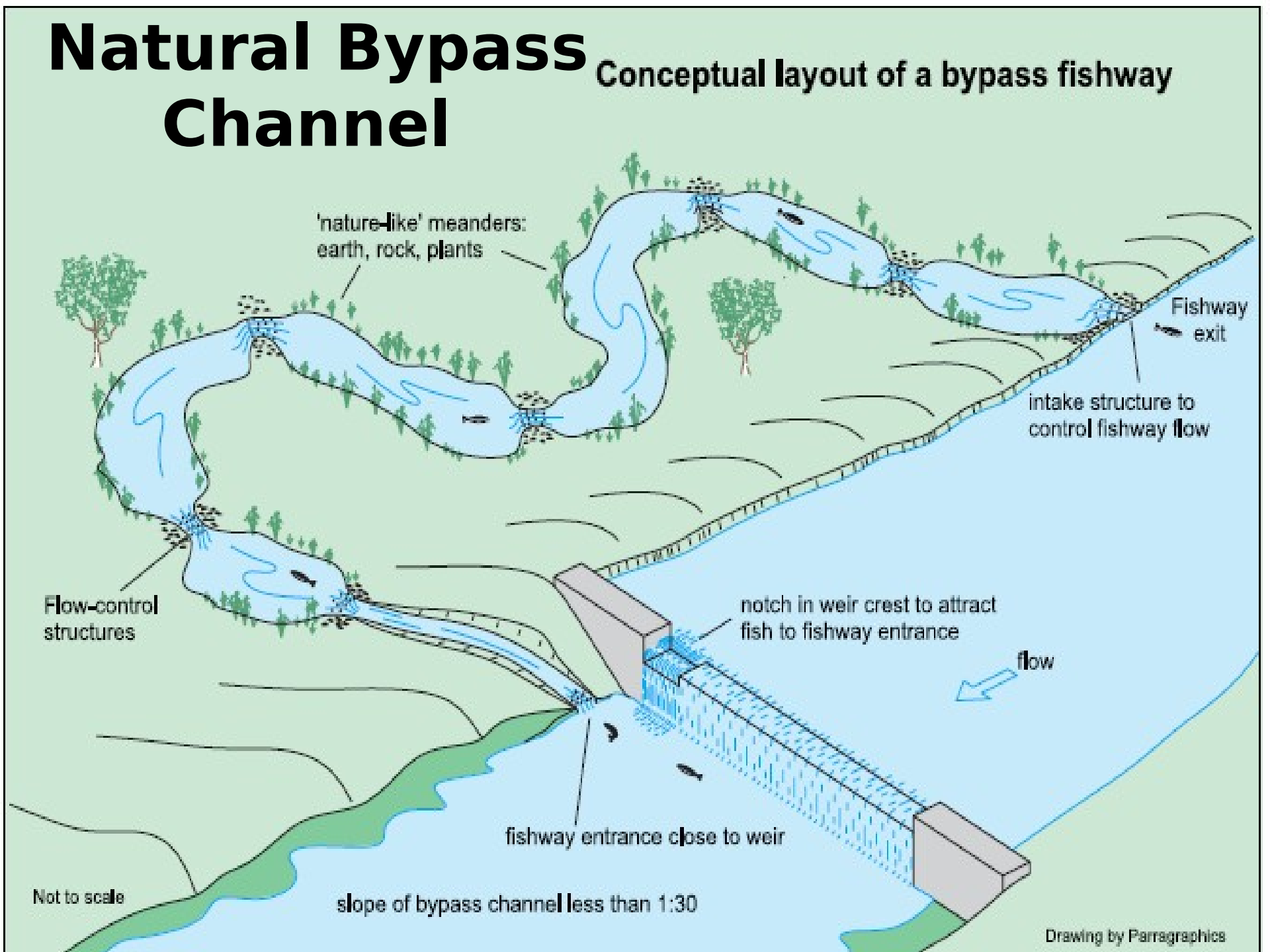
ROCK ARCH RAPIDS LONGITUDINAL PROFILE (centerline)

ROCK SIZED ACCORDING TO MAXIMUM SHEAR STRESS IN RAPIDS

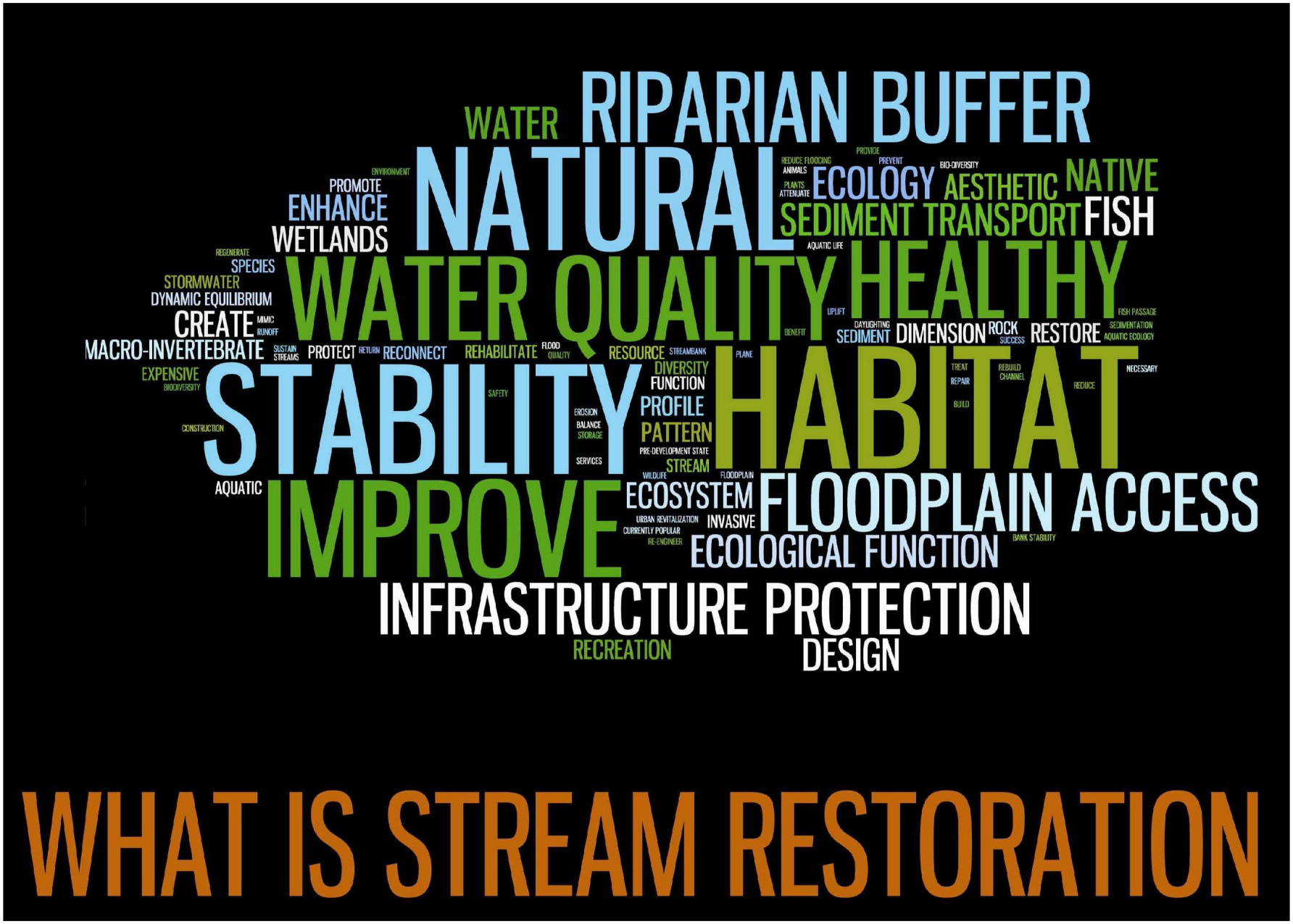


Designed by Luther Aadland, MNDNR

Natural Bypass Channel


Conceptual layout of a bypass fishway
'nature-like' meanders: earth, rock, plants
Fishway exit
intake structure to control fishway flow
Flow-control structures
notch in weir crest to attract fish to fishway entrance
flow
fishway entrance close to weir
Not to scale
slope of bypass channel less than 1:30
Drawing by Parragraphics

Natural Bypass Channel



WHAT IS STREAM RESTORATION

3. Stream Restoration

- **Hydrology and detailed measurements of the stream REQUIRED before beginning.**
- **Natural stream channel design using hydrogeomorphic principles.**
- **Techniques frequently used: log and rock vanes, bendway weirs, and bioengineering.**
- **To be ecologically successful, projects must involve restoration of natural river processes (e.g., channel**

Instream Structures

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Stream Restoration (cont.)

- Resist the over-stabilizing the project and smooth stream planform (lack of diversity). Some erosion is natural in a stream!
- Monitoring project performance and goals attainment should be on-going over the first several years. If necessary, use Adaptive Management.
- Minimal or no disturbance of functioning "good" portions of the stream and riparian system.

Other Stream Restoration Strategies

- Identify and utilize nearby available materials for stream restoration efforts.
- Utilize plant stock that is mature enough to provide seed in a short period of time (self-seeding riparian areas). Typically, lots of vegetation is used to stabilize the bank.
- Caution: Talk to professionals before proceeding!

Vegetative plantings as part of stream restoration

4. Wetland Creation / Restoration

- Hydrology, Hydrology, Hydrology!!!
- Replacing invasive species (e.g., common reed)
  with native vegetation.
- Volunteer species (natural seed bank) may be able
  to supplement project plantings.

Before

After

Hydrological and Geomorphology manipulation!!

MN Waterfowl Association

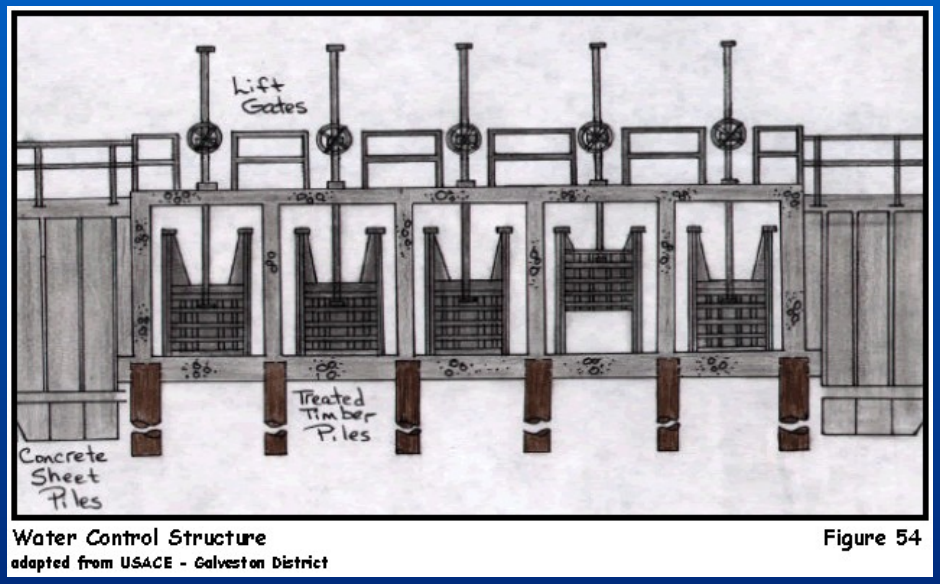
5. Beneficial Use of Dredged Material

Pumping dredged material
to restore the marsh

Elders Point, Jamaica Bay Salt Marsh Island Restoration, New York - June 2007

S. Water Control Structures

Pumps, Berms, etc.



Water Control Structure — Figure 54

adapted from USACE - Galveston District

After introducing tidal flow – the healthy native *Spartina* outcompetes the *Phragmites*

7. Artificially Placed Natural Structure

Rock and Natural Materials

Chesapeake Bay Oyster Recovery

Oysters filtered bay every 24 hrs in 1900. In 2000 it took 360 days.

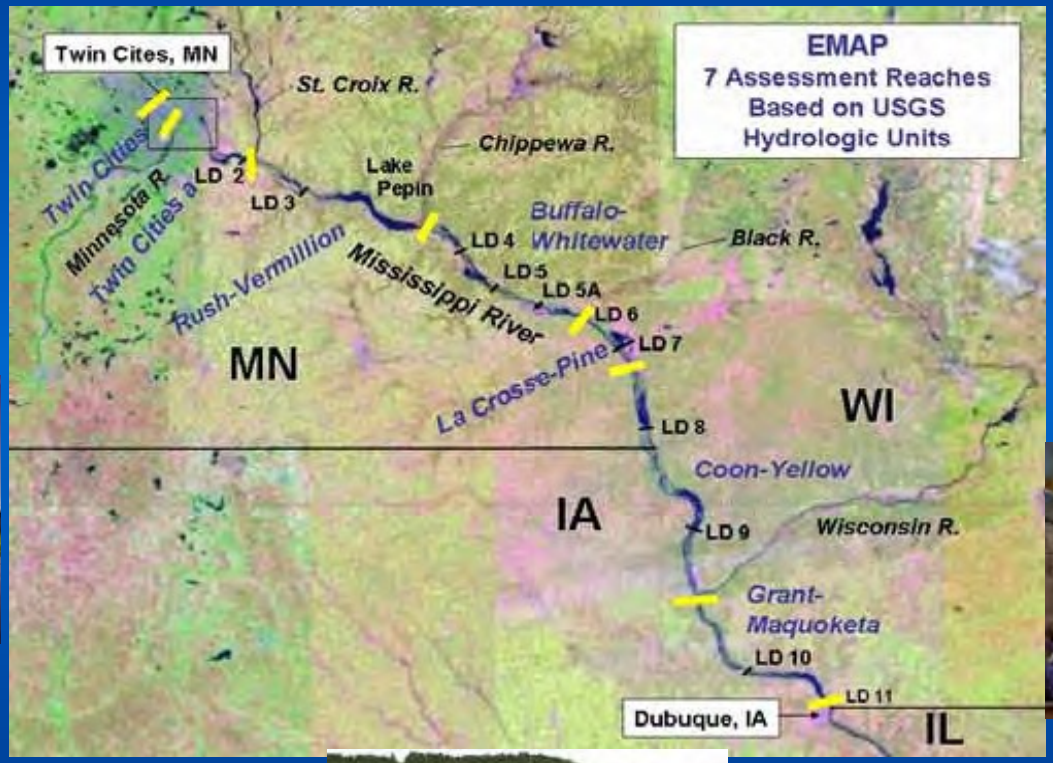
New Oyster Bars

1,200,000 bushels 1997-2000

8. Operational Management Measures

- Typically linked with features of a structure (i.e. dam)
- May involve change in operations
- May involve institutional actions

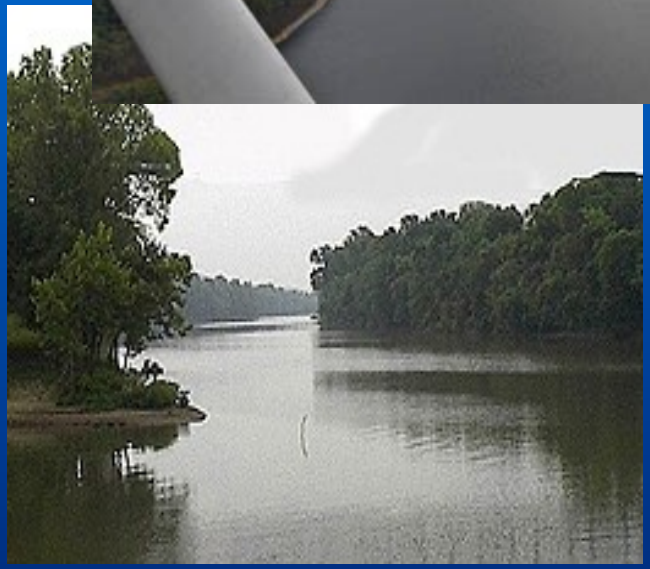
Mississippi Pools



Operational Example –Water Level Management

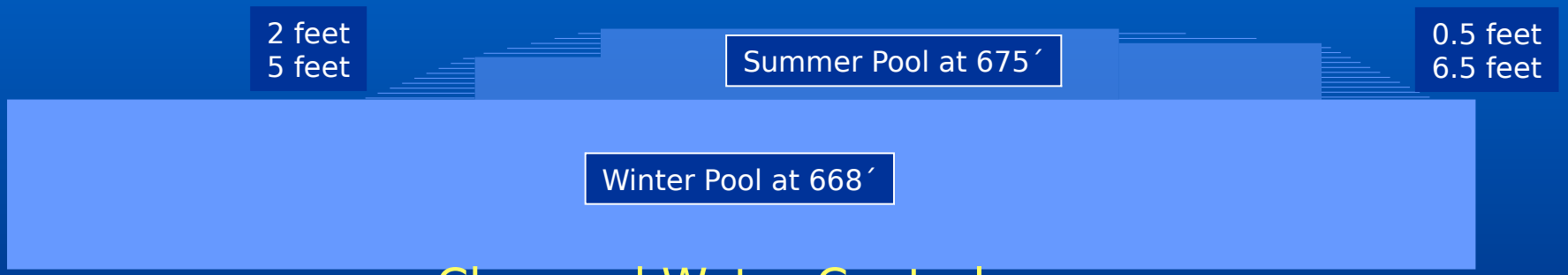
Pool Drawdown

Green River Lake. KY



Re-Operation of the Green River Dam

Initial Operation



Changed Water Control Plan

Varied release rates to mimic natural events

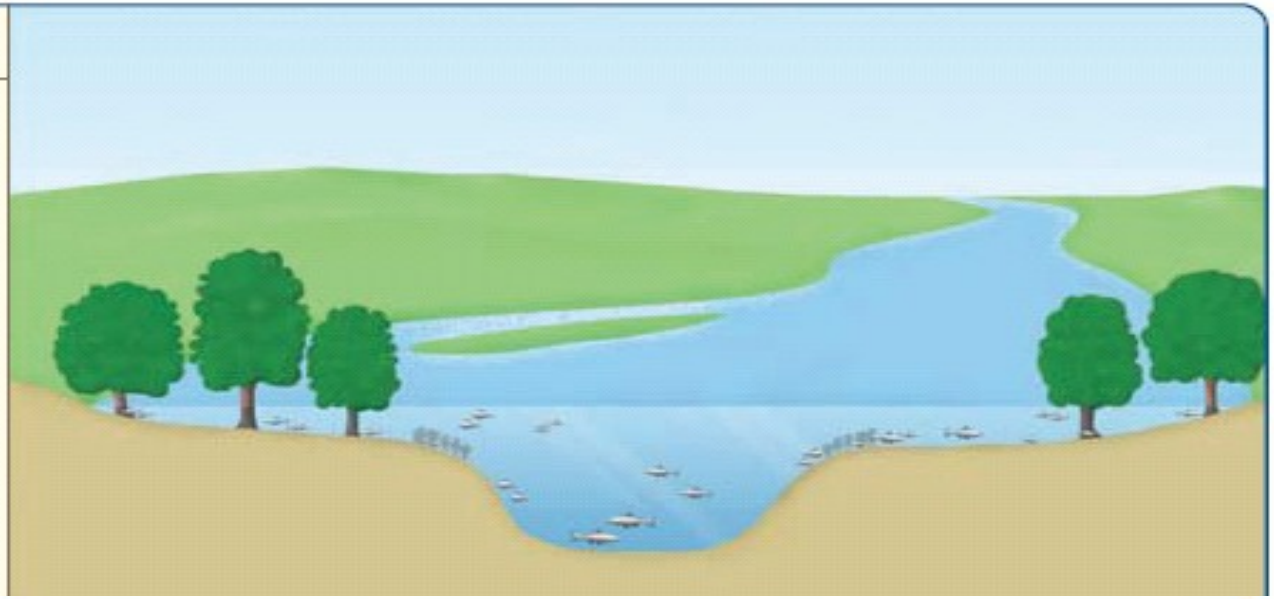
Natural Flood

Fish are able to feed and spawn in floodplain areas

Riparian plant seeds germinate on flood-deposited sediments

Insects emerge from water to complete their lifecycle

Wading birds and waterfowl feed on fish and plants in shallow



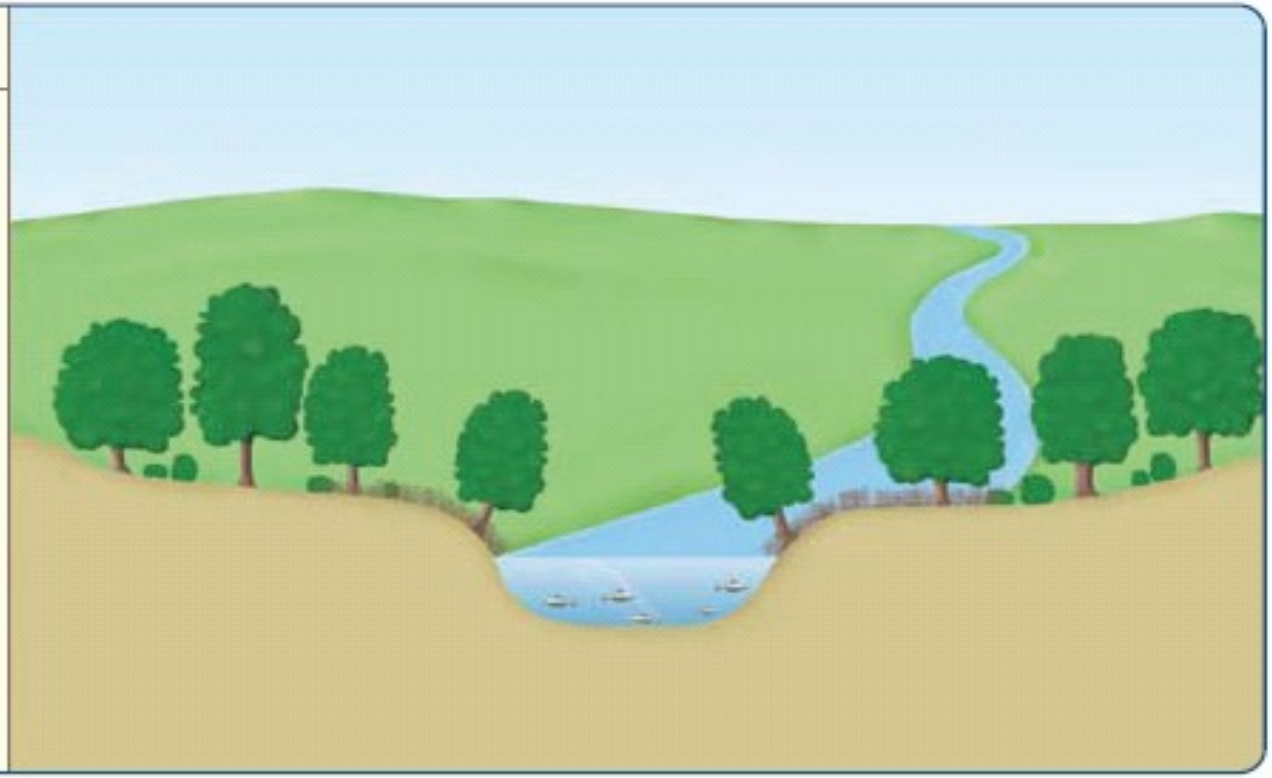
Absence of Flood

Fish unable to access floodplain for spawning and feeding

Riparian vegetation encroaches into river channel

Insect habitats smothered by silt and sand

Many birds cannot use riparian areas when plant species change



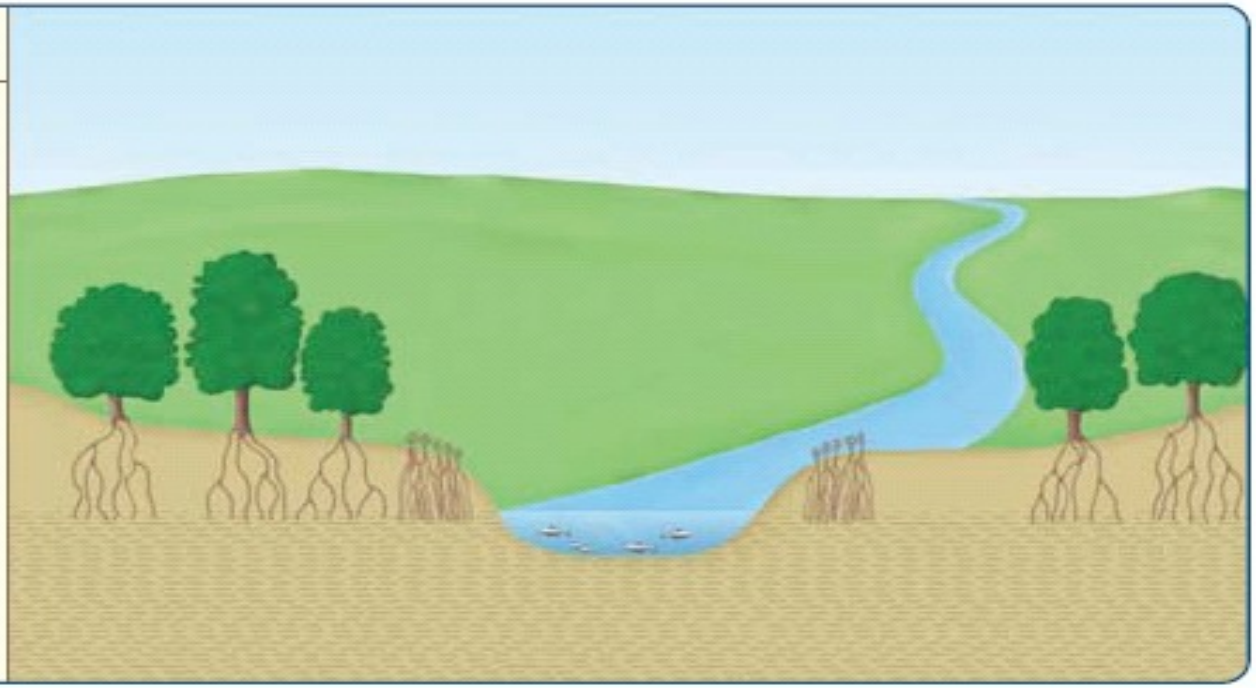
Natural Low Flow

Fish have adequate oxygen and can move up or downstream to feed

Riparian vegetation sustained by shallow ground water table

Insects feed on organic material carried downstream

Birds supported by healthy riparian vegetation and aquatic prey



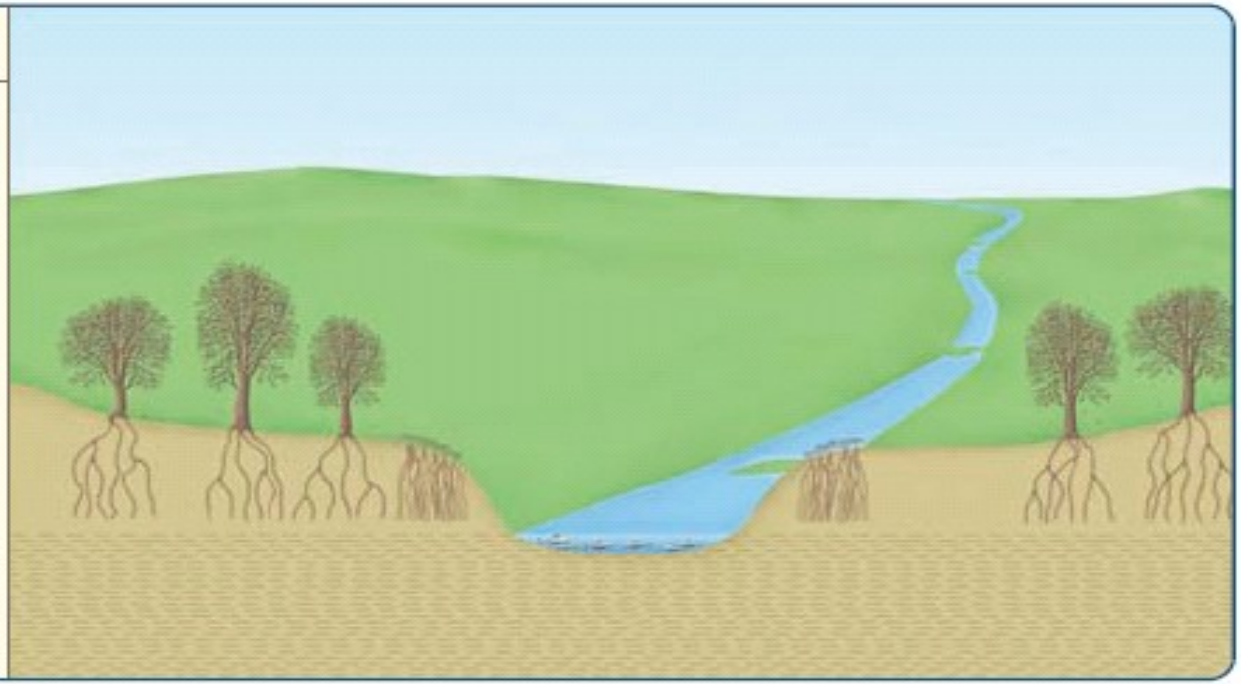
Inadequate Low Flow

Fish are overcrowded in poor quality water, cannot move to other feeding areas

Riparian plants wilt when ground water table drops too low

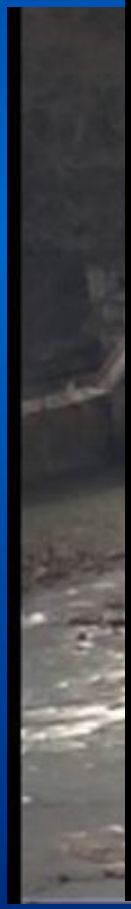
Insects suffer when water levels rise and fall erratically

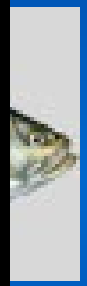
Birds unable to feed, rest, or breed in tree canopy



Corps Restoration / Mitigation Examples

Removal of Embrey Dam, VA
#1
Norfolk District





Opened approximately 8 mile
of habitat to migratory fish.
Target species: alewife

Batsto River Fishway Restoration Project
Section 206
Philadelphia District

#2

#3

Lower Cape May Meadows – Section 206 Philadelphia District

Before

After

Lower Cape May Meadows

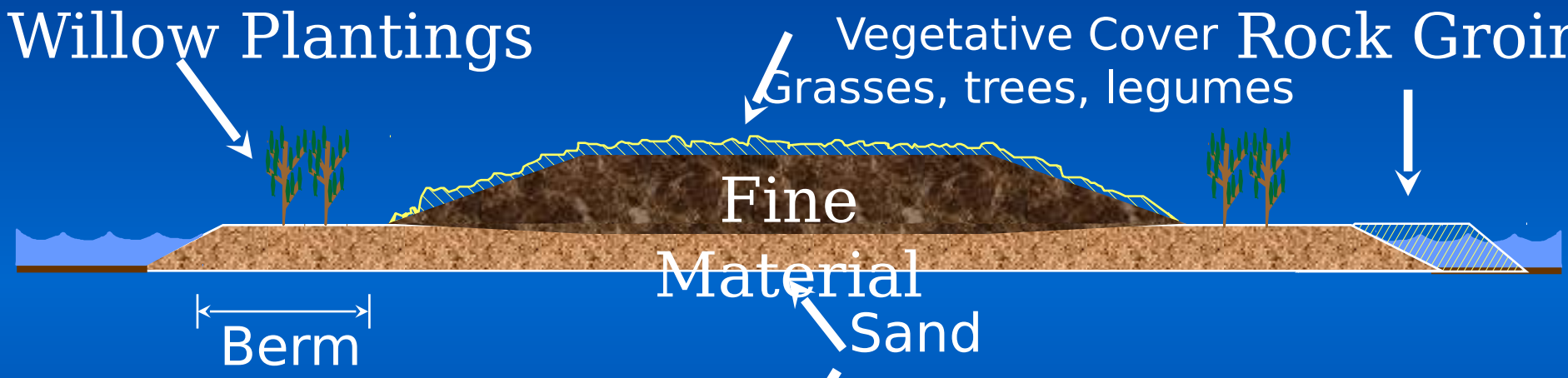
Restoring beach nesting habitat and freshwater wetlands

#4 Dredging & Island Creation

Rock Island District / Baltimore District

Objectives:
Restore Natural Flow Regime
Reduce Wave Action
Provide Terrestrial Habitat
Improve Aquatic Plant Growth
Create Winter Fish Habitat
Create Mudflat and Sandbar Habitat

Island Cross Section

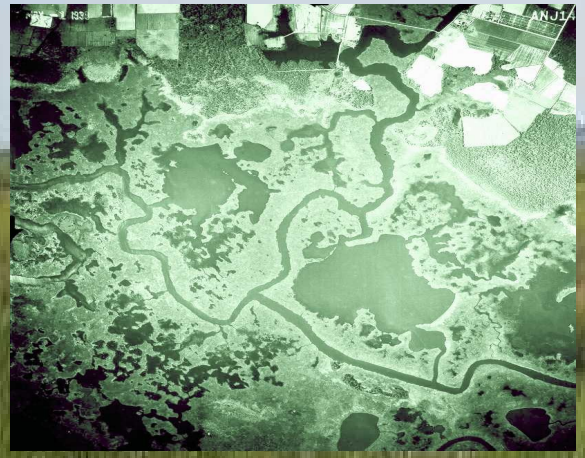


Poplar Island
Chesapeake Bay MD

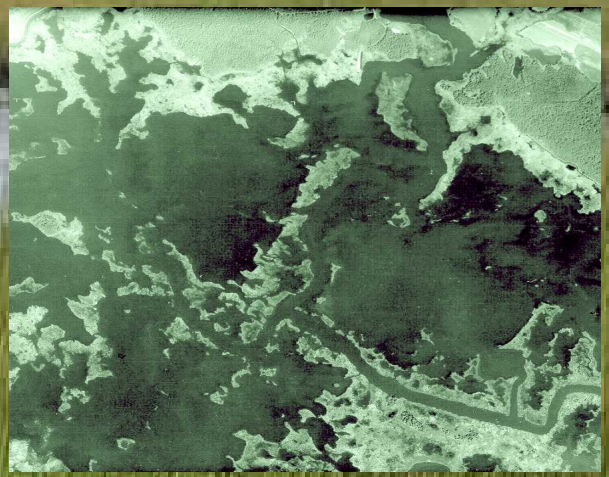
- Use of Dredged Material From Baltimore Harbor Approach Channels to Create 1140 Acres of Remote Island Habitat
- Completed Initial construction 2002
- Capacity: 38 Million Cubic Yards
- Project Cost: $427,000,000

#5 Baltimore District - BLACKWATER NWR MARSH RESTORATION

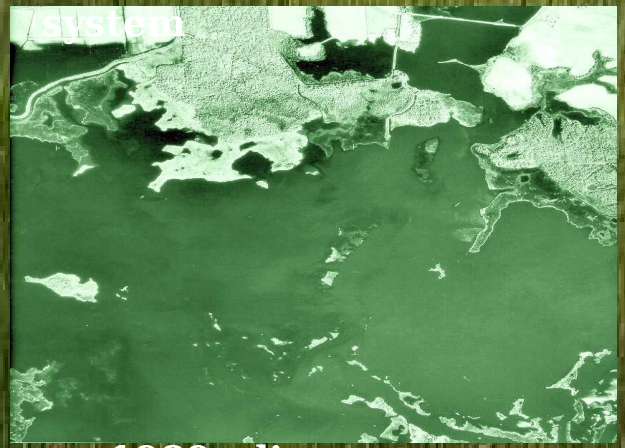
"The Disappearing Marsh"



1938--with discreet ponds and channels within the marsh system.



1974--breached ponds, integrity of the channels have been compromised and significant marsh loss is evident.



1989--discreet features have disappeared and severe marsh loss is

Blackwater totals:
Total Loss: Approximately 8000 acres
Loss Per Year: Approximately 130 acres

Restoration Measures

Thin Layer Spraying

Pumping and Dumpi

Vegetation Plantings

Post-Planting: Aug 2003

#6 Festival Park, a Partnership in Coastal Ecosystem Restoration – Section 206 Wilmington District

PROBLEM: 1,500 feet of coastal marsh and maritime forest were eroding along Festival Park's shoreline. This habitat is important for oysters, fish and wildlife and supports commercial fisheries.

Festival Park

Silt curtain and geo-textile fabric were used to minimize turbidity..

Gaps provide tidal exchange and access for marine larvae, fish, and shrimp.

Phased planting in April & May.

Festival Park
Before / After

BEFORE
- High Energy
- Eroding Shoreline
- Lacking Low Marsh

AFTER
- Low Energy
- Stable Shoreline
- Low Marsh Fringe

Take Away Points

- **Ecosystem restoration is a relatively new science. What we know is far exceeded by what we don’t know.**
- **Techniques are constantly changing and being revised.**
- **Find partners with experience and expertise in the technique you would like to use. Talk to EDRC professionals!**
- **Push the envelope and be creative!**
- **Remember: You can't build a reputation on what you are going to do. -- Henry Ford**

Additional Resources

- **ERDC Staff**
  - **Stream Restoration & Dam Removal Issues - Dr. Craig Fischenich**
  - **Stream Restoration - Dave Derrick**
  - **Riparian Habitats - Dr. Richard Fischer**
- **Other State and Federal Agencies**
- **Ecosystem Restoration (Corps Gateway) / Fish Passage**

http://cw-environment.usace.army.mil/restoration.cfm